Surgical Management of Left Ventricular Aneurysms by the Jatene Technique

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Few significant improvements in left ventricular aneurysm (LVA) surgery occurred from the time of Cooley's report of the first open resection using cardiopulmonary bypass in 1958[1] until Jatene[2] and Dor[3] reported entirely new reparative approaches in the mid-1980s. Most LVAs occur in the anteroseptal region and, as the name would imply, involve not only the anterior portion of the free-wall of the left ventricle but also the distal ventricular septum. Jatene realized that simple aneurysm resection and linear closure did nothing to correct the septal component of anteroseptal aneurysms and the first objective of his new approach was to overcome that deficiency. He did so by introducing the concept of imburcating the involved portion of the septum in order to stabilize it and to give the left ventricular free-wall a firm base against which it could contract.

Jatene also recognized that most anteroseptal aneurysms, certainly the larger ones, had dilated bases and that the dilitation of the aneurysm base pulled the non-aneurysmal left ventricular free-wall away from the septum (Fig 1). It seemed intuitive to him that this morphologic change in the geometry of the left ventricle would have the effect of decreasing global ventricular function independent of the more direct and apparent adverse effects of the aneurysm. Furthermore, if the base of the resected aneurysm were allowed to persist in its dilated state, the induced dysfunction of the nonaneurysmal left ventricular free-wall would continue to exist postoperatively. Jatene's solution was to alleviate that problem by placing an encircling purse-string suture around the base of the aneurysm and tightening it down until the ventricle resumed the shape it would have had if the myocardial infarction had occurred without the complication of an aneurysm. Jatene felt that by reconstructing the normal geometry of the left ventricle as much as possible while removing the aneurysm, the results of surgical therapy should improve. The Jatene technique and the similar technique described by Dor now represent the state-of-the-art in the surgical treatment of LVAs. This article is written to elucidate the underlying principles that determine the specific operative technique used in the Jatene repair of LVAs.

Since April, 1986, we have employed only the Jatene Repair for the treatment of LVAs in our own practice. Originally we performed all aneurysm resections, as did Jatene, with the heart in the normothermic, beating state on cardiopulmonary bypass. However, during the past four years, we have switched to the use of antegrade and retrograde warm-blood cardioplegia-induced arrest, followed by intermittent cold-blood cardioplegia delivered by both routes during performance of the procedure, followed by a period of controlled warm reperfusion with aspartate-glutamate enriched warm blood. All procedures are performed through a median sternotomy, and cardiopulmonary bypass access is through an arterial cannula in the ascending aorta and a double-lumen venous return cannula in the right atrium.

After the initiation of cardiopulmonary bypass, the aorta is cross-clamped and the heart is cardioplegically arrested as previously described. The aneurysm is opened by placing an incision parallel to and at least 2 cm lateral to the left anterior descending (LAD) coronary artery. Because this incision is transmural, care must be taken with small aneurysms to avoid placing it too close to the LAD and entering the ventricular septum or too far away from the LAD and damaging the anterior papillary muscle. The diagonal branch of the LAD coronary artery usually lies directly over the endocardial insertion of the anterior papillary muscle and can serve as a guide for placement of the ventriculotomy.

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Once the aneurysm is opened enough to insert a finger, the inside of the aneurysm is palpated to determine whether or not mural thrombus is present, to delineate the extent of the aneurysm, and to guide the extension of the ventriculotomy. When the final ventriculotomy has been completed, the inside of the aneurysm is visually inspected to determine the extent of involvement of the ventricular septum and the anterior papillary muscle. If no mural thrombus is present, a left ventricular vent is inserted through the right superior pulmonary vein.

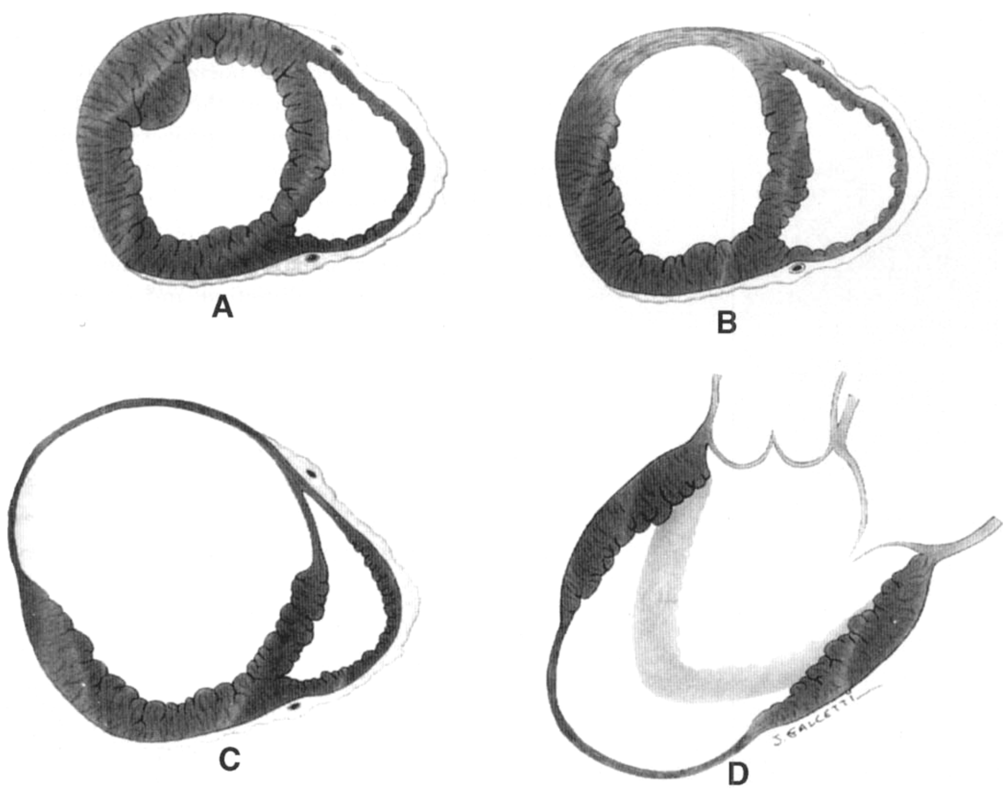


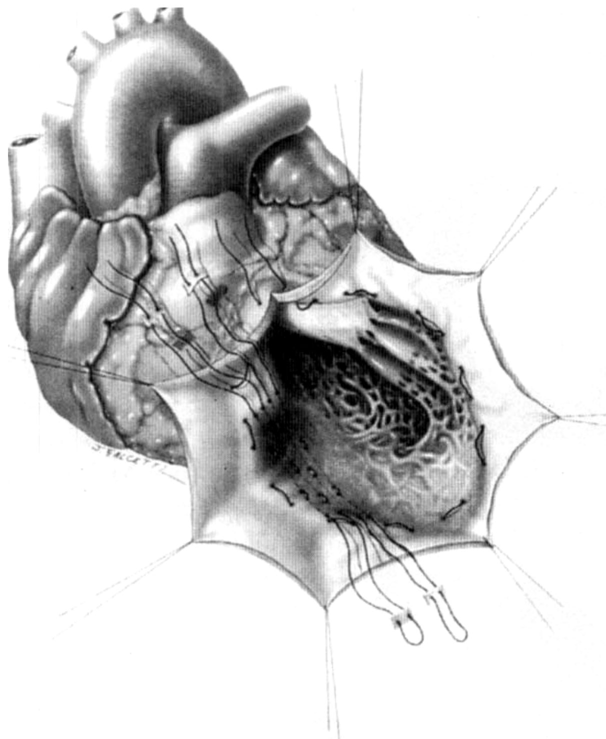
Figure I. (A) Short-axis cross-section of a normal heart. Note the relationship between the plane of the ventricular septum and that of the lateral free-wall of the left ventricle.

(B) Short-axis cross-section of a heart with a large anterior myocardial infarction in which no aneurysmal dilitation occurred. Note the preservation of the normal spatial relationship between the planes of the ventricular septum and the lateral free-wall of the left ventricle.

(C) Short-axis cross-section of a heart with a large anteroseptal left ventricular aneurysm. Note how the dilitation of the base of the aneurysm has caused the planes of the uninvolved septum and the uninvolved free-wall to "splay" or diverge at grossly different angles form the norm in A.

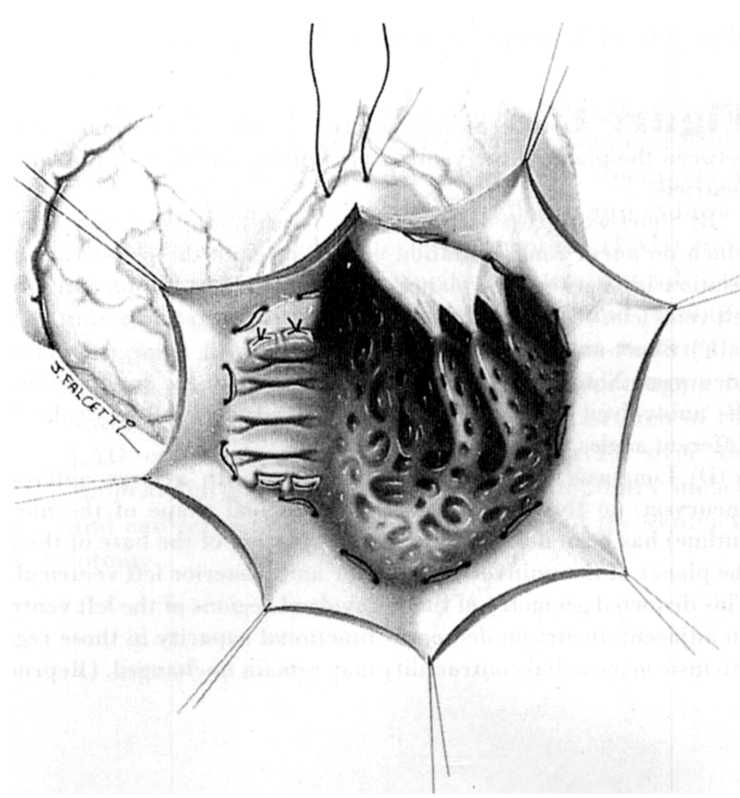
(D) Long-axis, cross-section of a heart with a large anteroseptal left ventricular aneurysm. In this view, the oblique, conical shape of the normal ventricle (shaded outline) has been destroyed by severe dilation of the base of the aneurysm. This causes the planes of the uninvolved anterior and posterior left ventricular walls to be parallel. This distorted geometry of the uninvolved regions of the left ventricle by the presence of an adjacent aneurysm decreases functional capacity in those regions even though their intrinsic myocardial contractility may remain unchanged. (Reproduced by permission.[4])

SURGICAL TECHNIQUE



1 After determining the location of the junction between functioning and nonfunctioning septal myocardium, the nonfunctioning portion of the ventricular septum is imburcated by placing large pledgeted sutures in a posterior-to-anterior direction beginning at the base of the dysfunctional septal area and progressing towards the apex with subsequent horizontal mattress sutures. Unless an unusually large portion of the distal left ventricular septum is involved, this imburcation process usually requires only two individual horizontal mattress sutures. The first is placed at the base of the involved portion of the septum where the amount of septum imburcated is the greatest. The next horizontal mattress suture is placed in a more apical position, still being passed from a posterior-to-anterior direction and positioned immediately adjacent to the first imburcation suture. The amount of septum imburcated with this suture is less than with the first one. By imburcating less septum with the suture placed nearer to the apex, the septum is tapered towards the apex as it was before ischemic injury.

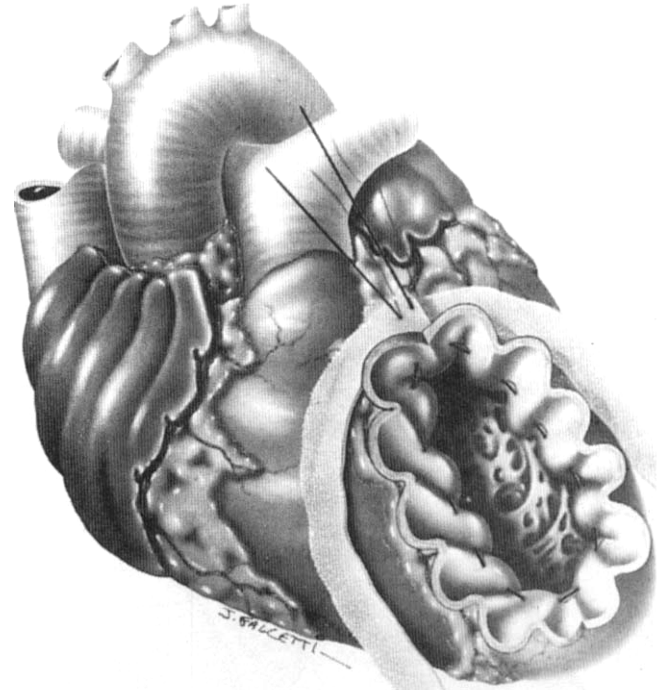
Note that the encircling suture has already been placed in this figure, although it is our preference to insert this suture after buttressing the septum (see Fig 2). (Reproduced by permission.[4])

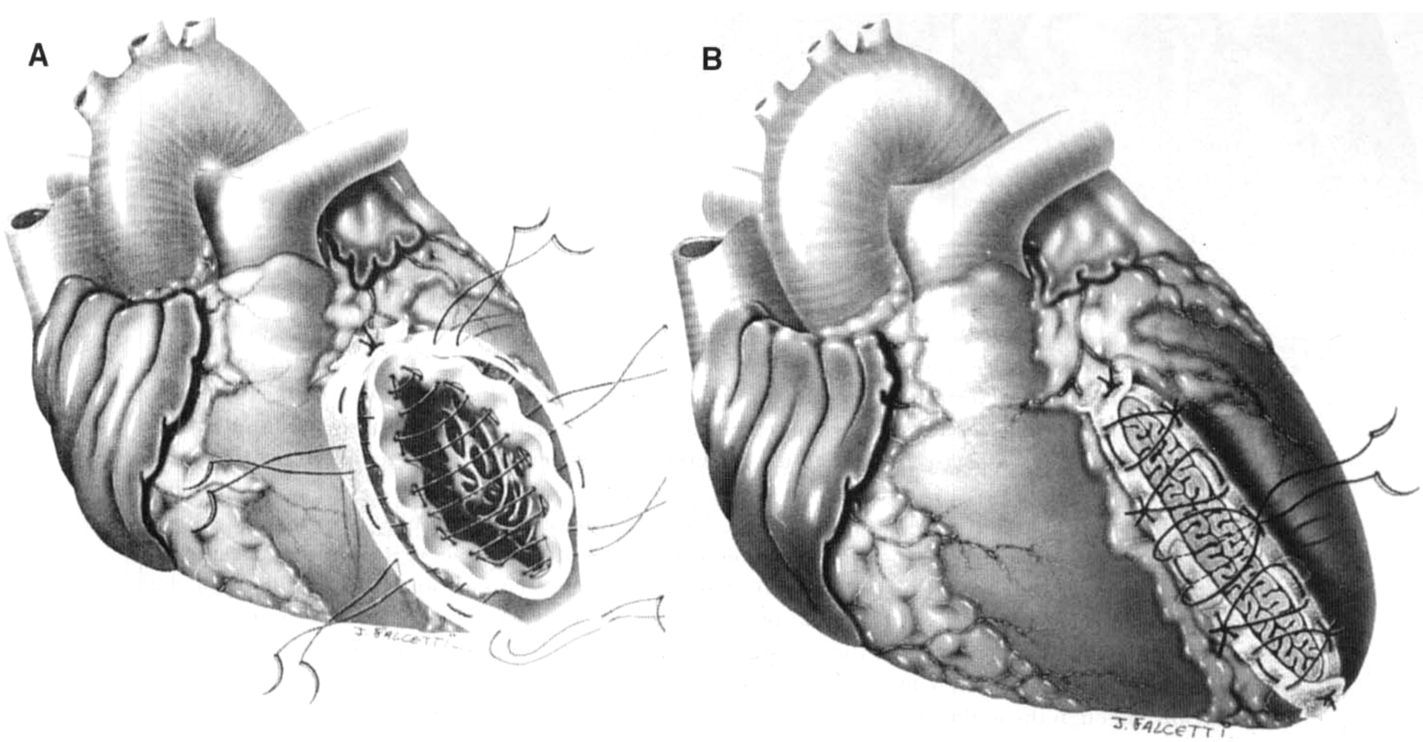


2 Once the septum has been stabilized by tying down the horizontal mattress sutures, attention is directed towards correcting the problem of the dilated base of the aneurysm. An endocardial purse-string suture is placed circumferentially around the base of the aneurysm at sufficient depth in the ventricular wall to "hold" when it is tightened down. The purse-string suture is normally placed on the free-wall endocardium at the junction of the endocardial scar and normal endocardium. However, if the endocardial scar extends proximal to the base of the papillary muscle or onto the papillary muscle itself, the purse-string suture is placed distal to the base of the two papillary muscles. In other words, under no circumstance is this purse-string suture ever to be placed on the free-wall of the ventricle proximal to the base of either papillary muscle. This free-wall suture is continued around the anterior base of the aneurysm until it reaches the junction of the anterior free-wall and anterior septum at the base of the aneurysm.

The other end of the purse-string suture is continued onto the distal septum at the apex and then proximally up the anterior septum at its junction with the free-wall. The suture is carried at this level to the base of the aneurysm anteriorly. Both ends of the purse-string suture are then passed transmurally through the anterior left ventricular free-wall and tied over a felt pledget. Because the purse-string suture is placed on the anterior edge of the septum and around the apex onto the free-wall, the imburcated septum is incorporated and remains a part of the wall of the left ventricular cavity. (Reproduced by permission.[4])

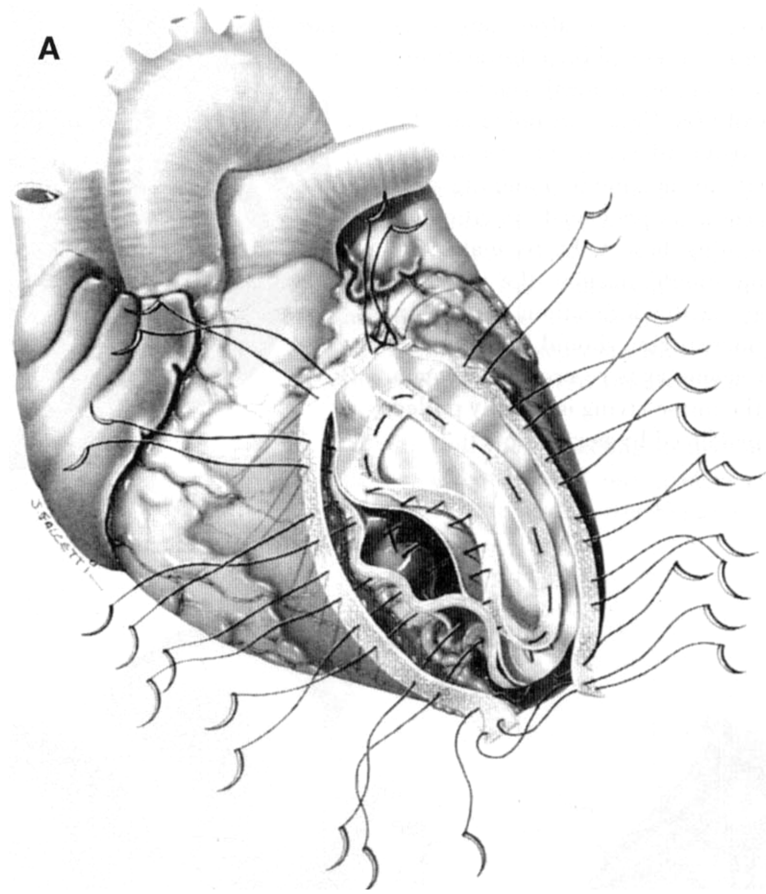
3 Once the purse-string suture is passed transmurally through the anterior left ventricular free-wall, it is tightened down tightly over a felt pledget. Tightening down the circumferential purse-string suture on the inside of the ventricle after stabilizing the septum "draws" the ventricular free-wall back towards the septum and restores the more oblique, conical relationship between the septum and free-wall (See Fig I). In doing so, the proper orientation of the myocardial fibers in the free-wall is re-established and the potential for maximum pumping efficiency of the ventricle is optimized. As previously mentioned, Jatene suggests that in determining how tight to make the purse-string suture, the surgeon should imagine the size and shape of the ventricle if only a myocardial infarction, and not an aneurysm, had occurred. The purse-string should be tightened to a point where that imaginary geometry is re-created. From a practical standpoint, however, the purse-string is usually pulled down as tightly as possible. (Reproduced by permission.[4])





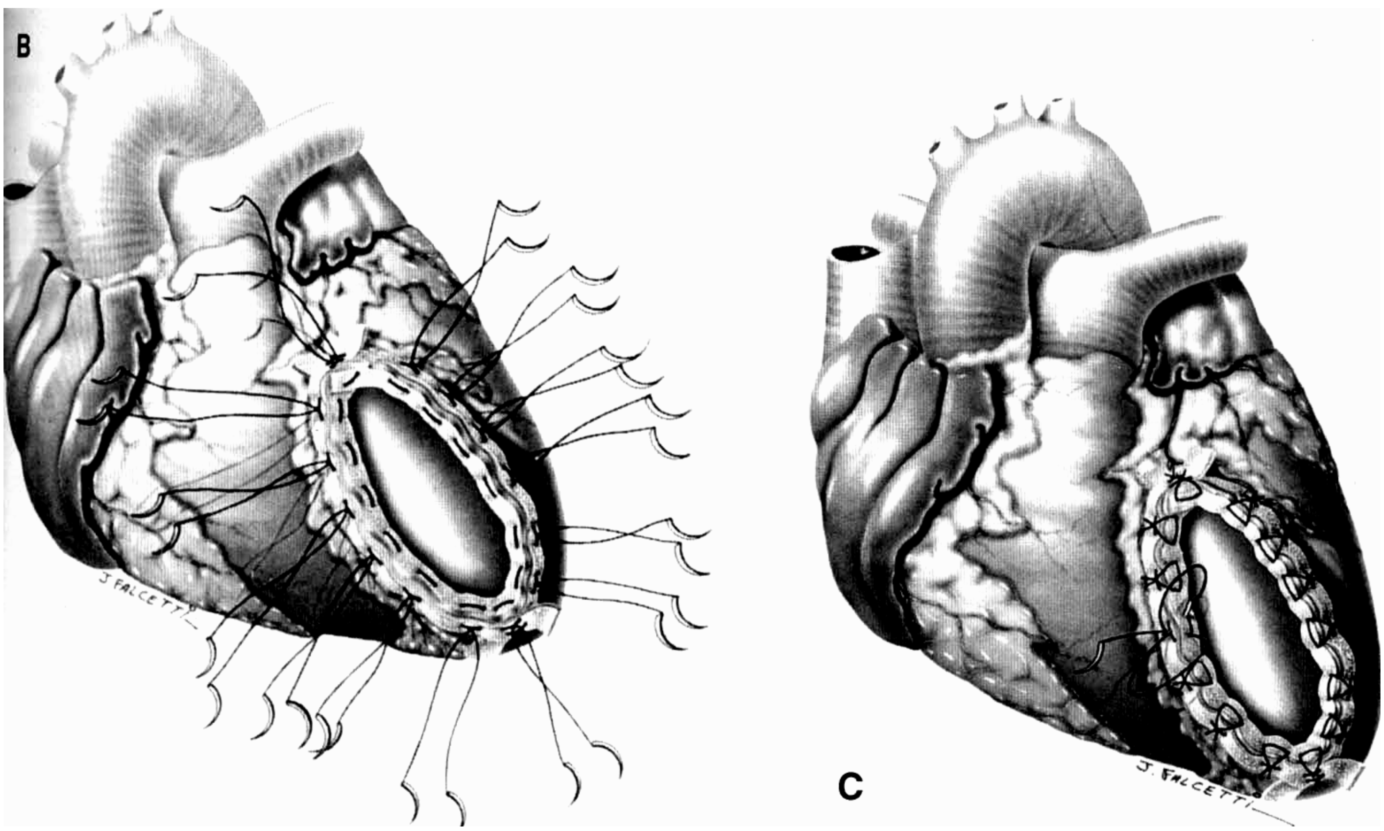
4 (A) If the opening in the ventricle is less than 3 cm in diameter after tightening the purse-string suture, the ventricle is closed in a linear fashion, placing large transmural sutures at the level of the purse-string suture. Once those sutures are tied down tightly, any excess aneurysm wall is excised.

(B) Final closure is with another row of figure-of-eight sutures for hemostasis. (Reproduced by permission.[4])



5 The degree to which the purse-string is tightened determines the size of the opening left in the ventricule and therefore determines whether a patch is required for closure. In our own experience, less than 25% of the Jatene repairs require patch closure. If after tightening the purse-string suture the opening is 3 cm or more, it is preferable to use a patch. We prefer bovine pericardium as the patch material.

(A) An endocardial patch is placed at the level of the purse-string suture. We usually fix the endocardial felt strips directly to the endocardium at the level of the purse-string suture, passing the sutures transmurally and then through matching epicardial felt strips as an endocardial-epicardial "sandwich" before suturing the endocardial patch into place. However, Jatene prefers to include the edges of the patch itself as a portion of the "sandwich" as depicted in this drawing. We secure the patch with additional interrupted 3-0 monofilament sutures placed through the edges of the patch then transmurally through the endocardial-epicardial "sandwich."



5 (Continued) (B) After the endocardial patch in position, the transmural sutures are tied down and any redundant aneurysm wall is resected at that time.

(C) A final row of figure-of-eight sutures for hemostasis completes the closure. We usually add a second bovine pericardial patch at the epicardial level to augment hemostasis. (Reproduced by permission.[4])

COMMENTS

Jatene has reported a series of 1,381 patients with an operative mortality rate of 5.8% and a late mortality rate of 4.5%.[4] Early and late evaluation showed an improvement in left ventricular function and long-term survival. Only 25% of these patients had single vessel coronary artery disease.

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